

EXECUTIVE SUMMARY
ACHIEVE’S STANDARDS ALIGNMENT ANALYSIS FOR KENTUCKY
JUNE 2005

Introduction

At the request of the Kentucky Department of Education, Achieve, Inc. conducted an analysis of several of the state’s mathematics standards documents, comparing them with Achieve’s American Diploma Project (ADP) benchmarks to determine the degree of alignment between them. The state of Kentucky has embarked upon a concerted effort to refine and strengthen its mathematics expectations for middle school and high school students and, at the same time, align those expectations with what national research shows students need to know and be able to do if they are to be prepared for college and the world of work. An impetus for Kentucky’s work has been its involvement in the American Diploma Project (ADP), a collaboration of Achieve, Inc., The Education Trust, and the Thomas B. Fordham Foundation designed to establish a strong link between the secondary and postsecondary communities. Kentucky’s recent commitment to join a partnership of 18 states in the ADP Action Network—a collaborative effort to identify and tackle challenges states face as they try to prepare all students for college or work—is an important next step in helping this dream become a reality.

For purposes of this analysis, Achieve was asked to analyze the mathematics expectations contained within the following documents and determine the degree to which these documents align with and support one another.

- Program of Studies for High School (last updated 1998)
- Program of Studies for Middle Level Mathematics (last updated 1998)
- High School Mathematics Core Content for Assessment (May 12, 2005 draft)
- Middle School Mathematics Content for Assessment (May 12, 2005 draft)
- Kentucky Statewide College-Readiness Standards in Mathematics (Attachment 3 to the Council on Postsecondary Education’s Statewide Public Postsecondary Placement Policy dated November 8, 2004)
- Achieve’s American Diploma Project (ADP) Mathematics Benchmarks (2004)

The study has been completed, and a draft report of findings has been presented to the Kentucky Department of Education. Included with the narrative report is a detailed “side-by-side” chart—an important tool in the study—that aligns comparable expectations from each of these documents.

General Summary of Findings and Recommendations

How Do Kentucky's College Readiness Standards compare with the ADP Benchmarks?

There is strong alignment between the Kentucky Statewide College Readiness Standards in Mathematics and Achieve's ADP benchmarks in mathematics when the two documents are compared in their entirety. Differences between the two documents arise when an examination is made of the expectations each defines as essential for all students. The Kentucky document defines three levels of expectation, with the first level being noted as essential gateway mathematical skills that students should have to avoid placement into remedial courses and succeed in an entry-level college course. The ADP mathematics benchmarks have two levels of expectation with all benchmarks except those noted with asterisks being deemed essential for all students. The major differences between the two documents are as follow:

- The ADP benchmarks define expectations with respect to technology for all students, while the KY College Readiness Standards define these standards as valuable but able to be acquired in college.
- The ADP benchmarks define as essential for all students a multitude of expectations with respect to data analysis, probability, and statistics. KY's College Readiness Standards classify those expectations that extend beyond basic data display, data interpretation, and summary statistics as knowledge that can be acquired in college.
- The ADP benchmarks place a greater emphasis on proof and construction than the KY College Readiness Standards do. The ADP benchmarks call for all students to be able to use geometric properties to prove and to perform constructions, in addition to being able to apply such properties to solve problems. The KY College Readiness Standards emphasize identification and application, in lieu of proof and construction, with any expectations addressing proof identified as essential only for those students whose intended majors require calculus and who expect to begin college taking calculus. The KY College Readiness Standards do not reference geometric constructions.

The ADP benchmarks and the KY College Readiness Standards have somewhat different purposes that help explain the aforementioned variations. While the Kentucky document is focused on college readiness, the ADP document has the broader mission of college and workplace readiness. While a worthy goal is to prepare all students so they have the opportunity to attend college, it is important that high schools also provide students with all of the skills they need to be prepared for a high performance workplace should they choose or be unable to attend college upon graduation. It is important that all students have facility with applying calculator and computer technology to solve problems. It is also important that all students have a solid foundation in data analysis and statistics so that they can make sound judgments in their personal and professional lives and be informed and critical consumers of mass media. Likewise, although students pursuing a major that is not mathematics-intensive and those entering directly into the workplace

may not need to be able to do formal geometric proofs and constructions, it is important that they come prepared with the strong sense of mathematical reasoning that such activities impart. It is important that Kentucky's K-12 standards—as they are revised and refined—embed these aspects of content and performance that are missing for all students in KY's College Readiness Standards.

How do Kentucky's expectations for secondary school compare with ADP and with Kentucky's College Readiness Standards?

There are notable gaps between Kentucky's grade 6-12 documents (Program of Studies and Core Content for Assessment), the KY Statewide College Readiness Standards, and the ADP benchmarks. While the full report discusses the variation across the documents in greater detail, a sampling of mathematical knowledge and skills that are included in the ADP benchmarks but not adequately addressed in the two KY documents defining expectations for grades 6-12 includes.

- Application of technology to solve problems
- Scientific notation
- Absolute value
- Complex numbers
- Need for geometric definitions, axioms, and theorems
- Geometric proof
- Geometric constructions
- Normal distribution
- Difference between correlation and causation

Of the two K-12 documents, the Core Content for Assessment is more comprehensive and more appropriately rigorous—and better aligned with both the KY College Readiness Standards and the ADP benchmarks. KY's Program of Studies and its Core Content for Assessment were drafted at different points in time and for different purposes. The intent of the Program of Studies—at the high school level—is to define the minimum content for the courses (Algebra I and Geometry) that comprise two of the three mathematics credits required for high school graduation. The purpose of the Core Content for Assessment is to define content that is essential for all students to know and that is eligible for inclusion on the state assessment—administered in high school at grade 11. One would hope that the content statements from these two documents would align reasonably well, but unfortunately this is not always the case. For example, the expectations defined in the Program of Studies for Algebra I place heavy emphasis on linear equations and functions. The Core Content for Assessment, on the other hand, ventures into more advanced algebraic concepts such as performing operations with polynomials and factoring quadratic polynomials. The result is a set of documents that offer varying perspectives on what is required of Kentucky high school graduates, hence creating the potential for confusion on the part of educators and the community. Specific details on the alignment of these various documents are provided in the body of the report.

What recommendations does Achieve have for improving the clarity and coherence of the Program of Studies, Core Content for Assessment, and College Readiness Standards—and ensuring alignment of all of these with the ADP mathematics benchmark?

- For the grade 6-12 documents, consideration should be given to creating one document that clearly communicates the level of mathematics knowledge and skills expected of Kentucky students when they graduate. While it was beyond the scope of this analysis to look at documents for grades K-5, the same recommendation appears to be pertinent for this grade span too. A single document could be designed in such a way as to include student standards, those aspects of the student standards deemed to be eligible for inclusion on statewide assessments, and even parameters/limits for assessment items. Maryland and Pennsylvania have both done work in the area, and their documents might serve as models for Kentucky. The existence of one document would go a long way toward achieving a consistent and clear voice about student expectations and make alignment with postsecondary expectations a more realistic task. If state regulation necessitates maintaining two documents, it is critical that steps be taken to bring the documents in closer alignment with one another.
- Achieve is currently working to “backmap” its ADP benchmarks in mathematics—creating a progression of content expectations by content domain that will extend over the high school years. Once these content progressions are completed, Achieve plans to parse these expectations into course sequences—both a traditional course sequence and an integrated sequence—to model how high school mathematics courses could look that culminate in meeting ADP’s benchmarks. At the same time, Achieve is working to ensure that this “backmapped” sequence aligns with the expectations Achieve set out earlier in its Mathematics Achievement Partnerships’s *Foundations for Success* document, which defines mathematics expectations for the middle grades. Kentucky might find Achieve’s work helpful in its revision process and/or to validate the work that it does independently.
- As work continues to define a coherent set of student expectations in mathematics, consideration should be given to creating examples to help clarify the intent and the level of rigor of the expectations. The ADP benchmarks and a number of state standards documents include examples as part of their standards. Pennsylvania—referenced earlier as a model for combining student expectations with assessment parameters—includes student expectations, assessment parameters, and examples in one document. An example of one page of this document is provided in the full report.
- As revisions and refinements are made, Kentucky should reconsider the wording of some of its expectations to make sure they are clear, concise, and pegged at the desirable degree of rigor. Content statements should be succinct enough that their intent and level of rigor can be described easily by examples. A standard such as one now in the Program of Studies indicates that students should “use the skills learned to solve linear equations and inequalities to solve numerically, graphically, or symbolically non-linear equations such as quadratic and

exponential equations.” This is a very broad standard, encompassing a multitude of content and performance expectations, and could be broken into more manageable expectations whose intent and level of rigor could be exemplified by sample problems. This would make for a more understandable and usable document. Care also needs to be taken in clearly articulating parameters and limitations on the expectations, for both the purposes of instruction and assessment.